Boot Band

Field of the Invention

[0001]

This invention relates to a boot band for clamping and fixing on another member a tube-like or boot-like member made of rubber, resin, or the like.

Background of the Invention

[0002]

A boot band is used, for example, to clamp a boot that covers the power transmission of an automobile, so that (1) internal grease and the like are prevented from flowing out from the boot, and (2) water and foreign matter are prevented from infiltrating into the boot. Also, because the boot band is used to clamp the member to be clamped under the condition that the boot band is wound around the member to be clamped, one pair of boot-band pawls are provided on the boot band so that a clamping tool can be hooked onto the boot-band pawls to clamp the boot band.

[0003]

Figures 11 and 12 show a first conventional boot band 1 (see Patent Document 1), and Figures 13 and 14 show a second conventional boot band 2 (see Patent Document 2). The boot band 1 or 2 consists of a band body 3 made of a thin metallic sheet, and is wound in a ring-like form so as to clamp the member in such a way that the boot band is wrapped completely around the member to be clamped. Therefore, when the band body 3 is wound (around the member to be clamped), the winding is done in such a way that the outer-layer portion of the band body 3 overlaps the inner-layer portion of the band body 3. Therefore, an outer layer portion 4 and an inner-layer portion 5 are formed.

[0004]

In the first conventional boot band 1, a first boot-band pawl 6 is formed on the outer-layer portion 4, and a second boot-band pawl 7, which forms a pair with the first boot-band pawl 6, is formed on the inner-layer portion 5. Engagement holes 8 and 9 are

formed in the area between the first boot-band pawl 6 and the end (free end) of the outer-layer portion 4. The engagement hole 8 is longer than the engagement hole 9, and the engagement hole 8 is also used as a temporary-tacking hole for temporarily tacking the band body 3. A second boot-band pawl 7, a temporary-tacking hook 10, and engagement pawls 11, 12 are sequentially arranged on the inner-layer portion 5 of the boot band 1 in the lengthwise direction of the band body 3 (in the clockwise direction in Figure 11).

[0005]

After the boot band 1 is wound like a ring as shown in Figure 11, the second boot-band pawl 7 and the temporary-tacking hook 10 are inserted into the engagement hole 8 of the outer-layer portion 4. Then, clamping tools (not shown) are hooked onto a pair of the boot-band pawls 6 and 7, and the boot-band pawls 6 and 7 are pressed toward each other in such a way that the distance between the boot-band pawls 6 and 7 shortens, so that the diameter of the ring-like band body 3 is reduced. The arrows F in Figure 12 indicate the directions of clamping. By this pressing, the engagement pawl 11 is inserted into and engaged with the engagement hole 8, and the engagement pawl 12 is inserted into and engaged with the engagement hole 9, so that a clamping condition — whereby the diameter of the boot band is reduced — is achieved.

[0006]

At this time, there is a space between the end section (i.e., the section near the engagement hole 9) of the outer-layer portion 4 and the inner-layer portion 5. The top of the end section of the outer-layer portion 4 is pressed from its outer peripheral side toward the center of said ring-like form. While maintaining such a pressed condition, the engagement pawl 12 is engaged with the engagement hole 9 so as to achieve final clamping.

[0007]

As shown in Figures 13 and 14, in the second conventional boot band 2, a first boot-band pawl 21 is formed on the top- and toward the end of the outer-layer portion 4, and a second boot-band pawl 22, which forms a pair with the first boot-band pawl 21, is formed on the inner-layer portion 5. Also, the first boot-band pawl 21 and engagement holes 23, 24, and 25 are sequentially formed on the outer-layer portion 4 along the

lengthwise direction of the band body 3 from the first boot-band pawl 21 side (in the counterclockwise direction in Figures 13 and 14), and engagement holes 26, 27, and 28 corresponding to these engagement holes 23, 24, and 25 are formed on the inner-layer portion 5.

[0008]

The second boot-band pawl 22 is press molded so as to rise outward in the radial direction, and an engagement hole 22a, which opens toward the first boot-band pawl 21, is formed in the second boot-band pawl 22. Also, the top end (free end) of the first boot-band pawl 21 of the outer-layer portion 4 serves as a terminal end 29 that extends in a flat form and that is inserted into the second boot-band pawl 22 through the engagement hole 22a.

[0009]

As shown in Figure 14, the band body 3 is placed — in a ring-like form — onto the member to be clamped so as to clamp the second conventional boot band 2 around the member to be clamped. Under this condition, a pair of pawls 15a and 15b of a clamping tool 15 are hooked and locked onto the boot-band pawls 21 and 22, so that the boot-band pawls 21 and 22 are pressed toward each other in the directions shown by arrows F, and whereby the diameter of the boot band is reduced. At the time of such pressing, while the terminal end 29 is inserted — in the direction shown by the arrow F — into the engagement hole 22a, the engagement pawls 26, 27, and 28 are engaged with their corresponding engagement holes 23, 24i and 25, thus achieving a clamping condition.

[0010]

Patent Document 1: Specification of U.S. Patent Re. No. 33744

Patent Document 2: Publication of Japanese Patent No. 3001266

Disclosure of the Invention

[0011]

In the first conventional boot band 1, shown in Figures 11 and 12, it is necessary that a load be applied onto the band body 3 in the circumferential direction by using a

clamping tool, that the outer-layer portion 4 be pressed inward while maintaining the above-mentioned loading condition, and clamping be done while maintaining the above-mentioned pressing condition. As such, two actions — one in the circumferential direction, and one inward —are necessary at the time of clamping, which makes the clamping operation troublesome. In addition, because two actions are necessary, there is the following problem: the time needed for a clamping operation is needlessly long, which adversely impacts workability.

[0012]

In contrast, in the second conventional boot band 2, shown in Figures 13 and 14, because the terminal end 29 is inserted into the engagement hole of the second boot-band pawl 22, the operation of pressing the outer-layer portion 4 inward is not necessary. Therefore, clamping can be performed by only one action, and clamping workability is improved in comparison with that of the first conventional boot band 1.

[0013]

However, in the case of the boot band 2 shown in Figures 13 and 14, the inner-layer portion 5 might buckle at the time of clamping.

[0014]

Figure 15 shows how such buckling 19 can occur. When clamping pressure is applied to the pair of boot-band pawls 21 and 22, the outer-layer portion 4 of the boot band 2 slides in the direction in which the load is applied. By this sliding, the outer-layer portion 4 climbs over the engagement pawl 26 of the inner-layer portion 5. However, at the time of this climbing over, the outer-layer portion 4 is hooked onto the top part of the engagement pawl 26, with which it becomes locked. By this locking, a load — which originally is to be used in sliding the outer-layer portion 4 and reducing the diameter of the boot band — is applied, via the outer-layer portion 4, onto the engagement pawl 26 of the inner-layer portion 5.

[0015]

Thus, even when a load is applied onto the pair of boot-band pawls 21 and 22, the condition becomes the same as that when the load is being received between the second boot-band pawl 22 and the engagement pawl 26 of the inner-layer portion 5. When the

clamping load on the band body 3 exceeds the buckling-resistance capability of the band body 3, buckling 19 occurs on the boot band 3 between the second boot-band pawl 22 and the engagement pawl 26 of the inner-layer portion 5.

[0016]

Figure 16 shows a countermeasure to prevent such buckling 19. That is, the distance L1 between the engagement pawl 26 of the inner-layer portion 5 and the first boot-band pawl 21 of the outer-layer portion 4 is made to be long. As a result, the terminal end 29 at the tip of the outer-layer portion 4 can clamp the inner-layer portion 5 while pressing that inner-layer portion 5 from the outside. Thus, buckling of the inner-layer portion 5 is prevented, and insertion of the terminal end 29 into the engagement hole of the second boot-band pawl 22 is facilitated.

[0017]

However, because when the countermeasure shown in Figure 16 is taken, the distance L1 between the engagement pawl 26 of the inner-layer portion 5 and the first boot-band pawl 21 of the outer-layer portion 4 is long, the overlapping portion between the outer-layer portion 4 and the inner-layer portion 5 also must be long, resulting in a need for a longer band body 3. As a result, the following problems arise: (1) the boot band becomes heavy, (2) its cost increases, and (3) there is limitation as to how much the diameter of the band can be reduced.

[0018]

The current invention has been made in consideration of the above-mentioned problems of the conventional boot bands. One objective of the present invention is to provide a boot band that features improved easiness in handling, and wherein — even though the boot band's structure is similar to that shown in Figures 13 and 14, where clamping the band body can be done in one action — buckling does not occur, and the length of the band can be shortened.

[0019]

To achieve the above-mentioned objective, the boot band of Claim 1 comprises

1. a band body that is wound as a ring around a member to be clamped, in such a way that an outer-layer portion overlaps an inner-layer portion of the band,

2. an engagement hole that is formed in the outer-layer portion of the band,

3. an engagement pawl that is formed in the inner-layer portion of the band and that engages with said engagement hole so as to maintain the band body in a clamped condition,

4. a first boot-band pawl that is formed on the top at and the end of the outer-layer portion of the band,

5. a planar terminal end that

a. is formed in the outer-layer portion of the band, and

b. is located closer/nearer to the top end of the outer-layer portion than the first boot-band pawl is,

6. a second boot-band pawl that

a. is formed in the inner-layer portion of the band,

b. has (1) an opening into which the terminal end can be inserted, and (2) a pressing part that presses — from the outside — the terminal end that is inserted into said opening, and

c. clamps the band body together with the first boot-band pawl, and

7. a slit that is formed between the first boot-band pawl and the engagement hole in the outer-layer portion of the band.

[0020]

In the invention of Claim 1, the band body that is in the form of a ring is clamped by the first boot-band pawl and the second boot-band pawl, so that the terminal end, which is located closer/nearer to the top end of the outer-layer portion than the first boot-band pawl is, is inserted into and pressed inside the second boot-band pawl. Thus, clamping can be performed by one action without needing to press the outer-layer portion against the inner-layer portion, thereby improving workability.

[0021]

In the invention of Claim 1, a slit is formed between the first boot-band pawl and the engagement hole. Therefore, the rigidity is low in the area where the first boot-band pawl, the slit, and the engagement hole are formed. Thus, a clamping force that is applied onto the pair of boot-band pawls makes it possible to press the top of the end section of the outer-layer portion against the inner-layer portion. That is to say, it is

possible to press against a portion that tends to buckle with the top of the end section of the outer overlap portion. At the same time, the load — which (1) is applied by the outer-layer portion, and (2) presses the top part of the engagement pawl inward — also is reduced. This can prevent buckling of the inner-layer portion.

[0022]

The amount of flexure — which is necessary for performing the above-mentioned pressing — is inversely proportional to the cross-sectional second moment in the above-mentioned portion. And because the cross-sectional second moment is reduced due to the slit formed in this portion, the flexure can be made large. As a result, it is not necessary that the distance between the first boot-band pawl of the outer-layer portion and the engagement pawl of the inner-layer portion be long for the purpose of obtaining adequate flexure. Thus, the distance between the first boot-band pawl of the outer-layer portion and the engagement pawl of the inner-layer portion can be short. As a result, the length of the band body can be reduced.

[0023]

The boot band of Claim 2 comprises

1. a band body that is wound as a ring around a member to be clamped, in such a way that the band body's outer-layer portion overlaps the inner-layer portion of the band body,

2. an engagement hole that is formed in the outer-layer portion of the band,

3. an engagement pawl that is formed in the inner-layer portion of the band and that engages with said engagement hole so as to maintain the band body in a clamped condition,

4. a first boot-band pawl that is formed on the top at and the end of the outer-layer portion of the band,

5. a planar terminal end that

   a. is formed in the outer-layer portion of the band, and

   b. is located closer/nearer to the top end of the outer-layer portion than the first boot-band pawl is,

6. a second boot-band pawl that

   a. is formed in the inner-layer portion of the band,

b. has (1) an opening into which the terminal end can be inserted, and (2) a pressing part that presses — from the outside — the terminal end that is inserted into said opening, and

c. clamps the band body together with the first boot-band pawl,

7. a slit that is formed between the first boot-band pawl and the engagement hole in the outer-layer portion of the band, and

8. a temporary-tacking pawl that

a. is formed on the inner-layer portion of the band, and

b. is inserted into and engaged with said slit, so that the band body is made to be in a temporary-tacking condition in a ring-like form.

[0024]

In the invention of Claim 2 — as is similar to the invention of Claim 1 — the terminal end that is to be engaged with the second boot-band pawl is formed in the outer-layer portion; therefore, clamping can be performed in one action. As also is similar to the invention of Claim 1, a slit is formed between the first boot-band pawl and the engagement hole; it is therefore possible to press the top of the end section of the outer-layer portion against the inner-layer portion, so as to prevent buckling the inner-layer portion. In addition, thanks to the above-mentioned slit, the flexure can be increased, and therefore the length of the band body can be shortened.

[0025]

The invention of Claim 2 provides, in addition to the above, a temporary-tacking pawl to be inserted into and engaged with the above-mentioned slit. As a result, a condition where the band body is temporary-tacked in a ring-like form can be stabilized. Also, because the temporary-tacking pawl guides the clamping of the band body width-wise, the band body can be smoothly clamped.

[0026]

The boot band of Claim 3 comprises

1. a band body that is wound as a ring around a member to be clamped, in such a way that the band body's outer-layer portion overlaps the inner-layer portion of the band body,

2. an engagement hole that is formed in the outer-layer portion of the band,

3. an engagement pawl that is formed in the inner-layer portion of the band and that engages with said engagement hole so as to maintain the band body in a clamped condition,

4. a first boot-band pawl that is formed on the top at and the end of the outer-layer portion of the band,

5. a planar terminal end that

a. is formed in the outer-layer portion of the band, and

b. is located closer/nearer to the top end of the outer-layer portion than the first boot-band pawl is,

6. a second boot-band pawl that

a. is formed in the inner-layer portion of the band,

b. has (1) an opening into which the terminal end can be inserted, and (2) a pressing part that presses — from the outside — the terminal end that is inserted into said opening, and

c. clamps the band body together with the first boot-band pawl, and

7. a reinforcing part that is formed between the second boot-band pawl and the engagement pawl.

[0027]

Also, in the invention of Claim 3, the terminal end to be engaged with the second boot-band pawl is formed in the outer-layer portion; thus, clamping can be performed in one action.

[0028]

In addition, in the invention of Claim 3, a reinforcing part is formed between the second boot-band pawl and the engagement pawl. As a result, the rigidity of this portion is high, and the cross-sectional second moment of this portion is large. And because a load that causes buckling is proportional to the section two-dimensional moment, even if a load — by which the outer-layer portion presses against the engagement pawl — is generated due to flexure of the outer-layer portion, buckling is prevented from occurring, because the buckling-resistance force is large. According to the invention of Claim 3, as is similar to the inventions of Claims 1 and 2, it is not necessary to take into

consideration the flexure of the outer-layer portion to prevent buckling, and therefore the length of the band can be shortened.

[0029]

The invention of Claim 4 is a boot band as described in Claim 3, and wherein said reinforcing part is a rib that is formed between the second boot-band pawl and the engagement pawl, and in the circumferential direction.

[0030]

In the invention of Claim 4, by forming a rib as the reinforcing part, the reinforcing part can be formed easily.

[0031]

The invention of Claim 5 is a boot band as described in any of Claims 1 through 3, and wherein an enlarged portion — which is on the side of the engagement hole, has a shape that corresponds to that of the rear end of the engagement pawl, and that is enlarged outward in the radial direction — is formed at said engagement hole's end face that is farther from the end of the outer-layer portion of the band.

[0032]

The invention of Claim 6 is a boot band as described in Claim 1 or 2, and wherein a enlarged portion — which is on the side of the slit, has a shape that corresponds to that of the back face of the engagement pawl, and is enlarged outward in the radial direction — is formed at said slit's end face that is farther from the end of the outer-layer portion of the band.

[0033]

In the inventions of Claims 5 and 6, if the engagement-hole-side enlarged portion and the slit-side enlarged portion are formed, the clamping operation can be performed smoothly, and an unnecessary load does not result. Therefore, buckling can be prevented even more surely.

[0034]

The invention of Claim 7 is a boot band as described in any of Claims 1 through 3, and wherein the end-section top portion of the outer-layer portion is curved inward in the

radial direction and has a curvature larger than that of the ring-diameter of the band body. In the invention of Claim 7, the end-section top portion of the outer-layer portion — which has a large curvature — surely presses the inner-layer portion at the time of clamping the band body. Therefore, buckling of the inner-layer portion does not occur.

Brief Description of the Drawings

[0035]

Figure 1 is a plane view of Embodiment 1 of the present invention.

Figure 2 is a cross-sectional view showing the clamping operation on Embodiment 1.

Figure 3 is a plane view of Embodiment 2.

Figure 4 is a cross-sectional view showing the clamping operation on Embodiment 2.

Figure 5 is a plane view of Embodiment 3.

Figure 6 is a cross-sectional view in Embodiment 3.

Figures 7(a) and (b) are a plane view and a cross-sectional view in a variation of Embodiment 4.

Figures 8(a) and (b) are a plane view and a cross-sectional view in another variation of Embodiment 4.

Figure 9 is a cross-sectional view showing the clamping operation on Embodiment 6.

Figure 10 is a cross-sectional view showing a clamping operation on Embodiment 5.

Figure 11 is a cross-sectional view of the winding condition of a first conventional boot band.

Figure 12 is a cross-sectional view showing a clamping operation on the first conventional boot band.

Figure 13 is a cross-sectional view of a winding condition of a second conventional boot band.

Figure 14 is a cross-sectional view showing a clamping operation of the second conventional boot band.

Figure 15 is a cross-sectional view showing buckling.

Figure 16 is a cross-sectional view, where buckling is prevented in the second

conventional boot band.

Explanation of Numbers in the Drawings

[0036]

30, 40, 50, 60, 70	Boot band
31	Band body
32	Outer-layer portion
33	Inner-layer portion
34, 35	Engagement hole
36, 37	Engagement pawl
38	Second boot-band pawl
38a	Opening
38b	Pressing part
41	First boot-band pawl
42	Slit
45	Temporary-tacking pawl
47	Rib
51	Slit-side enlarged portion
53	Engagement-hole-side enlarged portion
59	End-section top portion of outer-layer portion

Best Mode for Carrying Out the Invention

[0037]

The current invention will now be explained in detail, with reference to the drawings showing the several embodiments. The same numbers are used for the same items in the drawings of the different embodiments.

[0038]

(Embodiment 1)

Figures 1 and 2 show a boot band 30 in Embodiment 1 of the present invention, which

is formed with a belt-like band body 31.

[0039]

The band body 31 is formed by press-punching a thin metallic plate into the form of a belt that is used for clamping a member to be clamped (not shown) under the condition that the band body 31 is wound — in the shape of a belt or a ring — around the member to be clamped. The band body 31, which is wound like a ring, is formed with an outer-layer portion 32 that overlaps an inner-layer portion 33, and, as described below, these outer-layer and inner-layer portions 32, 33 are pressed in the diameter-reducing direction, so as to clamp the member to be clamped.

[0040]

A first boot-band pawl 41 is formed on the top of the end section (free end side) of the outer-layer portion 32 of the band body 31 so as to rise outward in the radial direction. Also, the terminal end 39 extends in the longitudinal direction of the free end, which is located nearer to the top of the end section than the first boot-band pawl 41 is. The terminal end 39 is formed (1) in a planar shape, and (2) so as to face a second boot-band pawl 38, which will be described later.

[0041]

In addition, engagement holes 34, 35 are sequentially formed in the lengthwise direction in the outer-layer portion 32. The engagement holes 34, 35 are engaged with the below-described engagement pawls 36, 37, so as to maintain the band body in a clamped condition 31.

[0042]

Engagement pawls 36, 37 are formed in the lengthwise direction in the inner-layer portion 33 of the band body 31. A second boot-band pawl 38 — which forms a pair with the first boot-band pawl 41 — is formed at a position adjacent to the engagement pawls 36, 37. The engagement pawls 36, 37 are formed so as to rise slantwise from the band body 31, and the rising ends of the engagement pawls 36, 37 are curved toward the second boot-band pawl 38. These engagement pawls 36, 37 are inserted into and engaged with the engagement holes 34, 35 of the outer-layer portion 32.

[0043]

The second boot-band pawl 38 is formed so as to rise atop the inner-layer portion 33. The second boot-band pawl 38 has an opening 38a and a pressing part 38b. The opening 38a is open on the side of the first boot-band pawl 41, so that the above-mentioned end 39 can be inserted thereinto. The pressing part 38b continues from the opening 38a in the circumferential direction, and acts so as to press the terminal end 39 — which is inserted in the opening 38a — from the outside.

[0044]

In addition to the above, the boot band 30 in this embodiment is provided with a slit 42 that is formed between the first boot-band pawl 41 in the outer-layer portion 32 and the engagement hole 34 adjacent to said first boot-band pawl 41. The slit 42 has a predetermined width, and extends in the lengthwise direction of the band body 31. The slit 42 has a width of about one-third of the width of the band body 31, and it is positioned in the approximate center, widthwise, of the outer-layer portion 32. The slit 42 in the outer-layer portion 32 serves to reduce the rigidity in the portion between the first boot-band pawl 41 and the engagement hole 34 in the outer-layer portion 32, so that adequate flexure can be obtained in the portion between the first boot-band pawl 41 and the engagement hole 34.

[0045]

In order that the boot band 30 in this embodiment can be clamped, the boot band 30 is wound in the form of a ring in such a way that the outer-layer portion 32 overlaps the inner-layer portion 33 on the outer periphery of a member to be clamped. Under this condition, a clamping tool (see the clamping tool 15 in Figure 14) is hooked onto the first boot-band pawl 41 and the second boot-band pawl 38, so that the outer-layer portion 32 and the inner-layer portion 33 are pressed in the diameter-reducing direction (i.e., toward each other) and then clamped. At the time of this clamping, the outer-layer portion 32 climbs over the engagement pawl 36 of the inner-layer portion 33, and a space having the height of the engagement pawl 36 is generated between the outer-layer portion 32 and the inner-layer portion 33, so that the outer-layer portion 32 becomes enlarged outward in the circumferential direction.

[0046]

In this embodiment, the slit 42 is formed between the first boot-band pawl 41 and the

engagement hole 34 in the outer-layer portion 32, resulting in low rigidity of this portion in the outer-layer portion 32. Due to the clamping force that clamps the boot-band pawls 41, 38, the top of the end section of the outer-layer portion 32 flexes toward the inner-layer portion 33, and thereby the end section of the outer-layer portion 32 is pressed against the inner-layer portion 33. Such pressing can prevent buckling from occurring in the inner-layer portion 33.

[0047]

The flexure that is necessary for pressing the outer-layer portion 32 against the inner-layer portion 33 is inversely proportional to the cross-sectional second moment in the portion between the first boot-band pawl 41 and the engagement hole 34 in the outer-layer portion 32. By forming the slit 42 in this portion, the cross-sectional second moment is reduced. Accordingly, the flexure can be made large. Thus, it is not necessary that the distance between the first boot-band pawl 41 of the outer-layer portion 32 and the engagement pawl 36 of the inner-layer portion 33 be made long in order to obtain adequate flexure. Therefore, the distance between the first boot-band pawl 41 of the outer-layer portion 32 and the engagement pawl 36 of the inner-layer portion 33 can be shortened. As a result, the length of the band body 31 can be shortened.

[0048]

In such an embodiment, the band body 31 can be shortened. Therefore, the boot band 31 can be lightweight, and the handling thereof is facilitated. Also, buckling does not occur even in a boot band that has a small diameter. In addition, in this embodiment, the first boot-band pawl 41 is positioned closer to the end of the top side than the engagement hole 34 is. Thus, by moving the first boot-band pawl 41, clamping can be performed in one action, resulting in improved workability.

(Embodiment 2)

[0049]

Figures 3 and 4 show Embodiment 2 of the present invention. The boot band 40 in this embodiment is provided with a temporary-tacking pawl 45 in addition to the elements of the boot band 30 in Embodiment 1.

[0050]

In this embodiment, a temporary-tacking pawl 45 is formed in the inner-layer portion 33, near the engagement pawl 36 and between the second boot-band pawl 38 and the engagement pawl 36. The temporary-tacking pawl 45 is formed so as to rise from the above-mentioned portion of the inner-layer portion 33 outward in the radial direction, and its width is such that it is insertable into the slit 42 of the outer-layer portion 32. When the band body 31 is wound like a ring, the temporary-tacking pawl 45 is inserted into and engaged with the slit 42 of the outer-layer portion 32. Such engagement makes possible a temporarily-tacked ring-like condition of the band body 31.

[0051]

In such an embodiment, when the temporary-tacking pawl 45 is inserted into and engaged with the slit 42, the band body 31 is temporarily tacked in a ring condition, so that the band body 31 can be handled under a stable ring condition, with the result that handling of the band body 31 is improved. Also, because the temporary-tacking pawl 45 guides the clamping of the band body 31 width-wise, the outer-layer portion 32 and the inner-layer portion 33 do not get dislocated in the width direction, so that the band body 31 can be smoothly clamped.

[0052]

Also, in this embodiment, a slit 42 that is similar to that of Embodiment 1 is provided between the first boot-band pawl 41 and the engagement hole 34 in the outer-layer portion 32. Thereby, because the top of the end section of the outer-layer portion 32 is pressed, causing the outer-layer portion 32 to flex toward and to press against the inner-layer portion 33, buckling of the inner-layer portion 33 can be prevented. Further, because the cross-sectional second moment is reduced, a high degree of flexure can be obtained, so that the distance between the first boot-band pawl 41 of the outer-layer portion 32 and the engagement pawl 36 of the inner-layer portion 33 can be shortened, with the result that the length of the band body 31 can also be shortened. Further, as is similar to Embodiment 1, when the band body 31 is clamped there is no need for pressing the outer-layer portion 32 toward the inner-layer portion 33, and thus clamping can be performed in one action, resulting in improved workability.

(Embodiment 3)

[0053]

Figures 5 and 6 show Embodiment 3 of the present invention. In this embodiment, a rib 47 is formed as a reinforcing part on the boot band 50.

[0054]

The rib 47 is formed between the second boot-band pawl 38 and the engagement pawl 36 in the inner-layer portion 33 of the boot band. In this embodiment, the rib 47 is formed with two parallel thin protrusion bars rising outward in the radial direction. The parallel rib 47 is formed in the circumferential direction so as to have approximately the same length as that between the second boot-band pawl 38 and the engagement pawl 36.

[0055]

The rib 47 is formed as a reinforcing part so that the rigidity of the boot band 50 between the second boot-band pawl 38 and the engagement pawl 36 in the inner-layer portion 33 becomes large, and so that the cross-sectional second moment also becomes large. Because a load that generates buckling is proportional to the cross-sectional second moment, even if such a load — by which the outer-layer portion 32 presses the engagement pawl 36 due to flexure of the outer-layer portion 32 — is generated, the increased buckling-resistance force can prevent buckling. In such an embodiment, there is no need to take into consideration the flexure of the outer-layer portion 32, so as to prevent buckling, and thereby the length of the band body 31 can be shortened. Further, by combining the structure of this embodiment with that of Embodiment 1, even when the band diameter is small — namely, when the curvature is small — buckling can be prevented.

[0056]

Figures 7 and 8 show, respectively, variations of this embodiment. In the embodiment of Figure 7, the rib 47 is one thin protrusion bar that is formed so as to extend in the circumferential direction between the second boot-band pawl 38 and the engagement pawl 36, under the condition that the rib 47 is positioned at the approximate center of the width of the inner-layer portion 33. In the embodiment shown in Figure 8, the rib 47 is a wide protrusion bar that is formed to extend in the circumferential direction

between the second boot-band pawl 38 and the engagement pawl 36. With such a rib 47, because the rigidity between the second boot-band pawl 38 and the engagement pawl 36 can be made large, buckling can be prevented, and the band body 31 can be shortened.

[0057]

In addition, a shape other than the shape of the rib 47 as shown in Figures 7 and 8 can be used for the reinforcing part. For example, an arc-shaped boss part can be formed at an appropriate location between the second boot-band pawl 38 and the engagement pawl 36.

(Embodiment 4)

[0058]

Figure 9 shows the boot band 60 in Embodiment 4 of the present invention. A slit-side enlarged portion 51 and an engagement-hole-side enlarged portion 53 are formed in the boot band 60 of this embodiment.

[0059]

The slit-side enlarged portion 51 is formed by enlarging its rear-end face (rear in terms of the clamping direction of the slit 42 of the outer-layer portion 32) outward in the radial direction. The engagement-hole-side enlarged portion 53 is formed by enlarging its rear-end face (rear in terms of the clamping direction of the engagement hole 34 of the outer-layer portion 32) outward in the radial direction. These enlarged portions 51 and 53 have curved shapes corresponding to back faces of the engagement pawls 36, 37. The engagement pawls 36, 37 can smoothly slide at the time of clamping.

[0060]

Because of the slit-side enlarged portion 51 and the engagement-hole-side enlarged portion 53, the outer-layer portion 32 can smoothly climb over the engagement pawls 36, 37 of the inner-layer portion 33, so that an excessive load is not applied on the inner-layer portion 33 and the inner-layer portion 33 is not buckled. Also, the terminal end 39 can be pressed toward the inner-layer portion 33 before the outer-layer portion 32 climbs over the engagement pawls 36, 37. Thus, the length of the band body 31 can be shortened. Further, the outer-layer portion 32 flexes, so that the terminal end 39 can be pressed against the inner-layer portion 33. Therefore, buckling of the inner-layer

portion 33 can be prevented more effectively.

[0061]

Variations of the embodiment 4 of the invention will now be explained. The embodiment 4 includes the slit-side enlarged portion 51 and the engagement-hole-side enlarged portion 53. However, if the outer-layer portion 32 does not include the slit 42, there is no need for forming the slit-side enlarged portion 51. If the band body 31 has a plurality of engagement holes, an engagement-hole-side enlarged portion can be formed for each of the engagement holes. In such a case, the engagement-hole-side enlarged portion 53 can be formed on the side of the engagement hole 35.

(Embodiment 5)

[0062]

Figure 10 shows a boot band 70 in Embodiment 5 of the present invention.

[0063]

In the boot band 70 of this embodiment, the portion of the end section of the outer-layer portion 32 has a high degree of curvature, and is designated by the number 59. In this embodiment, the end-section top portion 59 starts at the rear end of the first boot-band pawl 41, and ends at the end of the slit 42. The end-section top portion 59 of the outer-layer portion 32 is curved inward in the radial direction with a curvature larger than that of the ring diameter of the band body 31 that is wound around the member to be clamped.

[0064]

Thus, because the end-section top portion 59 of the outer-layer portion 32 has a high degree of curvature, buckling of the inner-layer portion 33 can be prevented. In other words, because the end-section top portion 59 of the outer-layer portion 32 has a high degree of curvature, when the outer-layer portion 32 climbs over the engagement pawl 36, the terminal end 39 at the tip of the outer-layer portion 32 ideally comes in contact with the inner-layer portion 33, and acts so as to press against the inner-layer portion 33. This prevents buckling of the inner-layer portion 33.

[0065]

In addition, such forming on the end-section top portion 59 can also be applied to a boot band of any of the Embodiments 1 to 4.

Industrial Applicability

[0066]

Although the boot band of the present invention has a structure in which the band body can be clamped in one action, the band body can be surely clamped without causing buckling in the inner-layer portion of the boot band at the time of clamping the band body. Further, the band length of the boot band can be made short, and the handling property thereof is superior to that of a conventional boot band.